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(54) Title of the Invention: Surface Cleaning and Lubricating Agent for Papermaking Drier

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SPECIFICATION

1. Title of the Invention

Surface Cleaning and Lubricating Agent for Papermaking Drier

2. Claims

1. A surface cleaning and lubricating agent for a papermaking drier, comprising (a) 50 to 98 weight parts oily material, (b) 1 to 20 weight parts nonionic surfactant, and (c) 1 to 20 weight parts cationic or amphoteric surfactant.

3. Detailed Description of the Invention

Field of Industrial Utilization

The present invention relates to a cleaning and lubricating agent for application to the surface of a papermaking drier.

Prior Art

Wastepaper use by paper plants has increased in recent years to conserve resources and to cut costs. This is accompanied by a tendency for increased consumption of coated and chemically treated products due to a more diversified demand for such products. Paper products manufactured on a papermaking machine are dried in the drying section of the machine, but the driers used in this case not only heat and dry the paper but also endow the paper products with smoothness and glossiness. This is because paper is pressed down firmly with touch rolls, and the smoothness of the drier surface is transferred to the paper being dried. It is thus extremely important for the drier surface to preserve its clean and smooth mirror finish.

In addition, tissue paper is provided with a crepe finish to achieve improved aesthetic appeal, handling, and softness, and to increase the commercial value of the product. Creating a fine and uniform crepe finish is therefore very important. Creping is commonly achieved by pressing doctor blades against the drier surface and separating the web from the drier surface. The size and quality of a crepe finish is therefore determined by optimum adhesion and separation balance between the web and the drier surface. For this reason, the drier surface must be kept clean and specular.

In current practice, the web is pressed against the drier surface and is caught in the irregularities on the surface, producing sludge. In addition, uneven contact of the doctor blades with the surface, an inability of the web to follow the speed of the papermaking machine, and other factors bring about increased coarseness and gradual sludge accumulation, resulting in staining and surface roughness. Paper stock contains large amounts of hot-melt adhesives, clay, pulp resin components, and other impurities contained in recycled paperboard. These fuse to the drier surface under heating, tear off short fibers from the paper, and deposit them on the drier as contaminants. Strength enhancing agents, sizing agents, and the like also contaminate the drier surface.

Pressing a doctor blade against the surface of a papermaking drier to scrape off the soil accumulated on the surface may be used as a method for removing soil from drier surfaces. When employed, however, this method produces a rougher surface, and although some relief is provided, the surface is rapidly contaminated and the doctor blade must be frequently replaced, which requires considerable time and labor.

According to another method, blankets, felts, and other materials impregnated with mineral oil (kerosene, spindle oil, or the like) or vegetable oil (rapeseed oil or the like) are pressed against the drier surface to transfer the oil thereto. The object is to prevent the web from adhering to the drier surface, and the short fibers of the web from being torn off in the process. In other words, it is believed that paper separation can be improved by the application of an oily material. To achieve this goal, ample amounts of release agents are sometimes applied by coating or spraying. These, however, end up forming oily films on the sludge or soil layer and fail to directly clean the drier surface. In addition, applying release agents in this manner causes excessive amounts thereof to be deposited, lifts the paper off the drier surface, impairs drying due to reduced heat conduction, causes more heated steam to be used, and brings about other problems related to reduced heat efficiency. In extreme cases, the paper is torn because of an excessive release effect, and the process must be stopped. In other words, such methods fail to comprehensively solve the above-described problems and require that the equipment be frequently stopped and cleaned, and the drier surfaces polished.

Problems Which the Invention Is Intended to Solve

An object of the present invention, which is aimed at addressing the above-described problems, is to clean the drier surface by removing the sludge or soil primarily responsible for these problems; to continuously maintain the cleaned surface in a smooth, specular state; and to thereby achieve improved heat efficiency, paper quality, papermaking speed, and productivity.

Means Used to Solve the Aforementioned Problems

The present invention resides in a surface cleaning and lubricating agent for a papermaking drier obtained by adding specific surfactants to a natural or synthetic oily material.

Specifically, the present invention resides in a surface cleaning and lubricating agent for a papermaking drier comprising (a) 50 to 98 weight parts, and preferably 75 to 96 weight parts, oily material; (b) 1 to 20 weight parts, and preferably 2 to 15 weight parts, nonionic surfactant; and (c) 1 to 20 weight parts, and preferably 2 to 10 weight parts, cationic or amphoteric surfactant.

A primary action of the oily material is to lubricate the area of contact between a drier surface and a doctor blade. Oiliness is a lubricating characteristic that allows an oil film to be formed between the contacting portions of two metals, reducing metal wear. Examples of such materials include animal and vegetable oils and fats obtained from natural sources; natural waxes; and mineral oils (spindle oil, machine oil, motor oil, and the like), petroleum waxes (microcrystalline wax, paraffin wax, and the like), and liquid paraffin obtained from petroleum. Additional examples include synthetic lubricating oils such as silicone oils, polybutene, polyethylene glycol, and synthetic esters.

Oily materials also have cleaning action. Some types of soil are highly soluble in oil and can readily dissolve in oily materials. Solvents may be cited as examples of such materials, with those having high flash points being preferred from a practical standpoint. Examples include ketones, petroleum spirits, mineral terpenes, and other hydrocarbons; 1,1,1-trichloroethane and other halogenated hydrocarbons; 2-ethylhexanol, isotridecanol, and other alcohols; and low-molecular-weight polybutenes and low-molecular-weight polyalkylene glycol ethers obtained by synthesis.

One of the actions of surfactants is to wash off the sludge and soil from a drier surface due to reduced surface tension, penetrating action, dispersing action, and other characteristics, and to emulsify oily materials in water. Nonionic surfactants may be used as such surfactants. A surfactant having an HLB value of 1 to 40, and particularly 6 to 20, is preferred for the object of the present invention.

Another surfactant action concerns chemical or physical adhesion of materials to the metal on the drier surface. This adhesion is believed to be caused by the adsorption of polar groups on a metal surface due to the orientation of the polar groups in surfactant molecules, causing hydrocarbon groups, which are oleophilic in nature, to become aligned in the direction away from the metal surface. Yet another action is adsorption on cellulose fibers. It is assumed that the polar groups in surfactant molecules are adsorbed on the cellulose fibers,
which are believed to be negatively charged, causing hydrocarbon groups to be oriented in the direction away from paper. Hydrocarbon groups are thus sandwiched as an intermediate layer between the surface of the paper and the metal surface of the drier, and the oily material is interposed therebetween. Cationic surfactants and amphoteric surfactants may be cited as examples of surfactants that can be used in this case.

Examples of cationic surfactants include long-chain alkyl (C_{10-22}) trimethyl quaternary ammonium salts, long-chain alkyl (C_{10-22}) dimethylbenzyl quaternary ammonium salts, heterocyclic quaternary ammonium salts, benzethonium chloride, long-chain alkyl (C_{10-22}) pyridium salts, alkyl (C_{10-22}) imidazolinium salts, and dialkyl (C_{10-22}) dimethyl quaternary ammonium salts.

Examples of amphoteric surfactants include alkyl (C_{10-22}) dimethylcarboxybetaines, alkyl (C_{10-22}) imidazolinium betaines, and dialkyl (C_{10-22}) methylcarboxybetaines.

The aforementioned cationic or amphoteric surfactants should preferably be soluble in oil, and particularly have alkyl groups whose carbon numbers range from 14 to 18.

Working Examples

The present invention will now be described through working examples. "Parts" refers to parts by weight.

Working Example 1

A drier surface cleaning and lubricating agent having the following composition was prepared.

Polybutene (average molecular weight: 340):	88 parts
Polyoxyethylene (3 mol) cocoalkyl ether:	8 parts
Polyoxyethylene (8 mol) polyoxypropylene (11 mol) cocoalkyl ether:	2 parts
Di-tallow alkylbetaine:	2 parts

The agent was tested during the manufacture of white paperboard. In conventional practice, an oil-impregnated blanket is pressed against a doctor blade to coat the drier surface in this process. However, sludge, pitch, and the like adhere to the drier surface and accumulate as soil there. For this reason, the drier surface becomes clouded, and the portions covered with sludge acquire a striped pattern. The striped pattern is transferred to the paper, facilitating fuzzing. In addition, paper tearing is caused by the erratic supply of oil to the blanket during oiling, considerable labor is involved in blanket replacement, and production efficiency is very low both in terms of time and in terms of economic efficiency.

An emulsified aqueous solution obtained by emulsifying 20 parts of the inventive composition in 1000 parts water was sprayed over an operating drier (width: 2 m) through nine spray nozzles at a rate of 1.0 L/min. After the spraying had been performed for about 30 minutes, the striped pattern started disappearing from the drier surface, and the entire surface became less cloudy and more glossy, and acquired a mirror finish in about half a day of spraying. This was accompanied by the disappearance of the striped pattern from the paper, no fuzzing occurred any longer, and higher paper quality was obtained. An increase in drying efficiency was also noted, and the steam pressure used could be lowered from 2.8 kg/cm^2 to 1.8 kg/cm^2.

Working Example 2

A drier surface cleaning and lubricating agent having the following composition was prepared.

Liquid paraffin (viscosity: 11 cst):	89 parts
Polyoxyethylene (3 mol) cocoalkyl ether:	7 parts
Sorbitan monooleate:	1 part

Oleyl imidazoline quaternary ammonium chloride: 3 parts

The agent was tested during liner fabrication.

In conventional practice, a large amount of water (20 L/min) is sprayed during such a process in order to prevent sludge deposition. For this reason, rust forms on the drier, the surface becomes rough, the finished surface of the paper loses its gloss, and paper tearing occurs particularly frequently due to the inadequate heating of corner portions. In addition, spraying large amounts of water increases heat loss and reduces production efficiency.

An emulsified aqueous solution obtained by emulsifying 5 parts of the above-described composition in 1000 parts water was sprayed over an operating drier (width: 3 m) through 30 spray nozzles at a rate of 1.5 L/min. The rust soon disappeared from the metal surface, an oil film formed instead on the metal surface, and the resulting lubricating action produced a "leveling" effect in the area of contact with the doctor blade. The leveling effect produced a smoother drier surface and resulted in an improved gloss on the finished surface of the paper. In addition, the large amounts of water were dispensed with, making it possible to achieve better drying properties, to reduce steam consumption from 3.5 kg/cm^2 to 2.3 kg/cm^2, and to prevent paper from tearing.

Working Example 3

A drier surface cleaning and lubricating agent having the following composition was prepared.

Machine oil (viscosity: 30 cst): 91 parts

Polyoxyethylene (8 mol) polypropylene (11 mol) cocoalkyl ether: 3 parts

Polyoxyethylene (8 mol) nonylphenyl ether: 3 part

Dihydrogenated tallow alkyldimethylammonium chloride: 3 parts

The agent was tested during the manufacture of dry-crepe toilet paper. In conventional practice, sludge-removing doctor blades are used in this process, but the production process is performed at a high papermaking speed with large amounts of deposited sludge. As a result, poor adhesion exists between the paper and the Yankee drier surface, nonuniformities develop during the separation of the web from the drier surface by the doctor blade, and uniform crepe is impossible to obtain. In addition, tear-like separation occurs, generating paper dust and resulting in a less favorable working environment. It is apparent that heat efficiency is also adversely affected.

An emulsified aqueous solution obtained by emulsifying 1 part of the above-described composition in 1000 parts water was sprayed over an operating Yankee drier (width: 3 m) through 30 spray nozzles at a rate of 2 L/min. After the spraying had been performed for about 1 hour, the deposited sludge was removed, the surface of the Yankee drier gradually became glossier, a uniform, fine crepe pattern was formed, and the paper became very soft to the touch. At the same time, a higher drying efficiency was obtained, the papermaking speed was increased by 10%, and the doctor blade replacement cycle was extended from 2 to 8 hours.

Working Example 4

A drier surface cleaning and lubricating agent having the following composition was prepared.

Machine oil (viscosity: 14 cst):	60 parts
Polybutene (average molecular weight: 1000):	30 parts
Polyoxyethylene (8 mol) polyoxypropylene (11 mol) cocoalkyl ether:	3 parts
Di-tallow alkyldimethylammonium chloride:	4 parts
Dimethyl cocoalkylbetaine:	3 parts

The agent was tested during the manufacture of tissue paper. In conventional practice, a release agent is added to the pulp slurry in this process, but the resulting release properties lack uniformity, a uniform crepe pattern is difficult to obtain, and a large amount of release agent must be added.

An emulsified aqueous solution obtained by emulsifying 1 part of the composition in 1000 parts water was sprayed with the aid of 40 spray nozzles over an operating Yankee drier (width: 4 m) at a rate of 3 L/min.

As a result, a uniform, fine crepe pattern was obtained, and the product was soft to the touch. Whereas the monthly consumption of a conventional release additive was 900 to 1000 kg, a monthly consumption of 100 to 110 kg was sufficient for the present invention.

Comparative Example 1

The composition shown below was used. This composition contained neither cationic nor amphoteric surfactants.

Liquid paraffin (viscosity: 11 cst):	90 parts
Sorbitan monooleate:	5 parts
Polyethylene glycol (molecular weight: 600) monooleate:	5 parts

The composition was tested in the same manner as in Working Example 2, but sludge remained partially deposited on the drier surface, and glossy spots had formed on the finished surface of the paper product. In addition, the deposited sludge had caused increased wear in the doctor blade and reduced the replacement period thereof from 8 to 3 hours.

Comparative Example 2

The composition shown below was used. This composition contained an anionic surfactant instead of the cationic or amphoteric surfactant.

Machine oil (viscosity: 15 cst):	86 parts
Polyoxyethylene (8 mol) polyoxypropylene (11 mol) cocoalkyl ether:	3 parts
Polyoxyethylene (3 mol) cocoalkyl ether:	8 parts
Sodium dodecylbenzenesulfonate:	3 parts

The composition was tested in the same manner as in Working Example 3, but the surface of the Yankee drier could not be kept sufficiently clean, lower drying efficiency resulted, sludge deposition occurred, and the doctor blade was severely worn, requiring replacement every 3 hours. For this reason, the crepe finish was nonuniform, and production efficiency could not be increased.

Merits of the Invention

The inventive surface cleaning and lubricating agent for a papermaking drier is emulsified with water in an arbitrary ratio and applied to the drier surface, making it possible to obtain a clean, smooth, and specular surface and to maintain the resulting state. Drying efficiency can thereby be increased, and optimum separation from the drier surface can be achieved. As a result, a paper product with an improved surface gloss can be obtained, and tissue paper can be provided with a crepe finish that renders the paper product soft to the touch. Productivity can also be increased because higher heat efficiency is achieved, a faster papermaking process is established, surfaces are abraded to a lesser extent, the doctor blades are replaced less frequently, paper loss is reduced, paper dust is prevented from being generated, and the like.

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